receiving bay. Surface **2044** is able to be cleaned periodically, for example with common cleaning agents (e.g., a 10% bleach solution), to ensure that any liquid spills that may occur during sample handling do not cause any short circuiting. Such cleaning can be carried out frequently when the heater unit is disposed in a diagnostic apparatus, and less frequently but more thoroughly when the unit is removed.

**[0058]** Other non-essential features of heater unit **2020** are as follows. One or more air vents **2052** can be situated on one or more sides (such as front, rear, or flanking) or faces (such as top or bottom) of heater unit **2020**, to permit excess heat to escape, when heaters underneath receiving bay **2014**, are in operation. The configuration of air vents in FIG. **2**, as a linear array of square vents, is exemplary and it would be understood that other numbers and shapes thereof are consistent with routine fabrication and use of a heater unit. For example, although 5 square air vents are shown, other numbers such as 1, 2, 3, 4, 6, 8, or 10 air vents are possible, arranged on one side, or spread over two or more sides and/or faces of the heater unit. In further embodiments, air vents may be circular, rectangular, oval, triangular, polygonal, and having curved or squared vertices, or still other shapes, including irregular shapes. In further embodiments two or more vents need not be disposed in a line, parallel with one another and with an edge of the heater unit but may be disposed offset from one another.

**[0059]** Heater unit **2020** may further comprise one or more guiding members **2047** that facilitate inserting the heater unit into an apparatus as further described herein, for an embodiment in which heater unit **2020** is removable by a user. Heater unit is advantageously removable because it permits system **2000** to be easily reconfigured for a different type of analysis, such as employing a different cartridge with a different registration member and/or microfluidic network, in conjunction with the same or a different sequence of processing operations. In other embodiments, heater unit **2020** is designed to be fixed and only removable, e.g., for cleaning, replacement, or maintenance, by the manufacturer or an authorized maintenance agent, and not routinely by the user. Guiding members **2047** may perform one or more roles of ensuring that the heater unit is aligned correctly in the apparatus, and ensuring that the heater unit makes a tight fit and does not significantly move during processing and analysis of a sample, or during transport of the apparatus.

**[0060]** Guiding members shown in the embodiment of FIG. **2** are on either side of receiving bay **2044** and stretch along a substantial fraction of the length of unit **2020**, but such an arrangement of guiding members is exemplary. Other guiding members are consistent with use herein, and include but are not limited to other numbers of guiding members such as 1, 3, 4, 5, 6, or 8, and other positions thereof, including positioned in area **2051** of unit **2020**, and need not stretch along as much of the length of unit **2020** as shown in FIG. **2**, or may stretch along its entire length. Guiding members **2047** are shown having a non-constant thickness along their lengths. It is consistent herein that other guiding members may have essentially constant thickness along their lengths. At the end of the heater unit that is inserted into an apparatus, in the embodiment shown, the edges are beveled to facilitate proper placement.

**[0061]** Also shown in FIG. **2** is an optional region of fluorescent material, such as optically fluorescent material **2049**, on area **2051** of heater unit **2020**. The region of fluorescent material is configured to be detected by a detection system further described herein. The region **2049** is used for verifying the state of optics in the detection system prior to sample processing and analysis and therefore acts as a control, or a standard. For example, in one embodiment a lid of the apparatus in which the heater unit is disposed, when in an open position, permits ambient light to reach region **2049** and thereby cause the fluorescent material to emit a characteristic frequency or spectrum of light that can be measured by the detector for, e.g., standardization or calibration purposes. In another embodiment, instead of relying on ambient light to cause the fluorescent material to fluoresce, light source from the detection system itself, such as one or more LED's, is used to shine on region **2049**. The region **2049** is therefore positioned to align with a position of a detector. Region **2049** is shown as rectangular, but may be configured in other shapes such as square, circular, elliptical, triangular, polygonal, and having curved or squared vertices. It is also to be understood that the region **2049** may be situated at other places on the heater unit **2020**, according to convenience and in order to be complementary to the detection system deployed.

**[0062]** In particular and not shown in FIG. **2**, heater/sensor unit **2020** can include, for example, a multiplexing function in a discrete multiplexing circuit board (MUX board), one or more heaters (e.g., a microheater), one or more temperature sensors (optionally combined together as a single heater/sensor unit with one or more respective microheaters, e.g., as photolithographically fabricated on fused silica substrates). The micro-heaters can provide thermal energy that can actuate various microfluidic components on a suitably positioned microfluidic cartridge. A sensor (e.g., as a resistive temperature detector (RTD)) can enable real time monitoring of the micro-heaters, for example through a feedback based mechanism to allow for rapid and accurate control of the temperature. One or more microheaters can be aligned with corresponding microfluidic components (e.g., valves, pumps, gates, reaction chambers) to be heated on a suitably positioned microfluidic cartridge. A microheater can be designed to be slightly bigger than the corresponding microfluidic component(s) on the microfluidic cartridge so that even though the cartridge may be slightly misaligned, such as off-centered, from the heater, the individual components can be heated effectively.

Heater Configurations to Ensure Uniform Heating of a Region

**[0063]** The microfluidic substrates described herein are configured to accept heat from a contact heat source, such as found in a heater unit described herein. The heater unit typically comprises a heater board or heater chip that is configured to deliver heat to specific regions of the microfluidic substrate, including but not limited to one or more microfluidic components, at specific times. For example, the heat source is configured so that particular heating elements are situated adjacent to specific components of the microfluidic network on the substrate. In certain embodiments, the apparatus uniformly controls the heating of a region of a microfluidic network. In an exemplary embodiment, multiple heaters can be configured to simultaneously and uniformly heat a region, such as the PCR reaction chamber, of the microfluidic substrate. The term heater unit, as used herein, may be used interchangeably to describe either the heater board or an item such as shown in FIG. **2**.

**[0064]** FIG. **4** shows a cross-sectional view of an exemplary microfluidic cartridge to show relative location of PCR channel in relation to various heaters when the cartridge is placed